



**I SANTA MARIA WORKSHOP ON CHEMISTRY
DEVOTED TO SUPRAMOLECULAR CHEMISTRY**

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ANALYSIS OF THE CREEP BEHAVIOUR OF POLY(METHYL METHACRYLATE)

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1. Introduction

Previous models for the interpretation of the creep behaviour of polymers are mainly empirical or semi-empirical, and do not take into direct account the physical (molecular) underlying mechanisms responsible for the material's non-linear viscoelastic behaviour. In the present study, a physical model is developed to describe the creep compliance of polymer materials (applicable to both amorphous and semi-crystalline polymers), at varying tensile stresses and ambient temperatures.

2. Experimental

Material

This particular work focused on an amorphous polymer – a poly(methylmethacrylate) – as 150 mm x 10 mm x 4 mm test specimens, cut and adequately machined from sheets.

Creep Tests

The creep measurements were carried out with a Zwick Z100 Universal Tensile Testing Machine, equipped with a 2.5 kN load cell and using a Macro extensometer with a deformation measurement range of 100 mm. The strain/force vs. time experimental data were automatically collected, stored and treated on a personal computer.

The test specimens were previously conditioned at 23 °C, and the creep tests were conducted at each selected temperature (30, 40 and 50 °C) in a thermostatic chamber, under applied stresses of 10, 16, 20, 25 and 32 MPa.

3. Creep

The main characteristic of a polymer creep process (far from rupture) is a progressive strain increase at a decreasing rate, until this rate reaches either a constant (under viscous flow) or a zero value (cross-linked amorphous or semi-crystalline polymer).

By generalizing Voigt-Kelvin's linear viscoelastic model, it is possible to write for the creep compliance

$$D(t) = D_0 + \int_{-\infty}^{+\infty} L(\tau) \left(1 - e^{-\frac{t}{\tau}}\right) d \ln \tau + \frac{t}{\eta} \quad , \quad (1)$$